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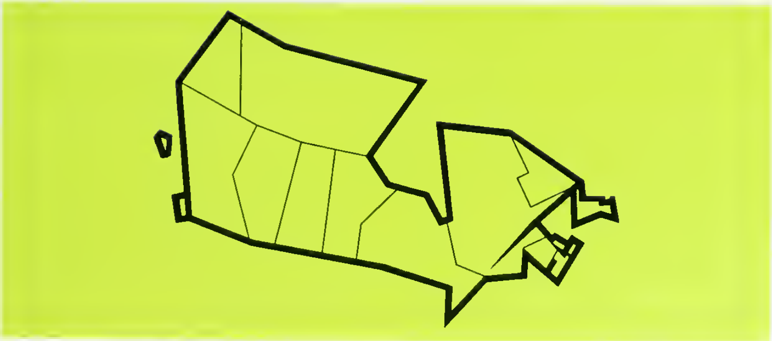

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Estimated soil moisture conserved by summerfallowing on the Canadian prairies

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Introduction

Soil moisture is one of the most important factors affecting crop production in the prairie region. Acceptable economic levels of yield can only be achieved if moisture supplies during the growing season are adequate to meet the requirements of the crop. In years when rainfall is insufficient, the crop utilises water stored in the soil at seeding.

The amount of moisture stored in the soil can be increased by various soil, crop and snow management practices, as well as by summerfallowing. Summerfallowing should be used cautiously since it can be detrimental to soil quality through increased erosion, nutrient loss and salinization, particularly if excessive tillage is used for weed control. However, if used carefully, summerfallowing can be an effective measure for reducing the risk (probability) of crop failure due to inadequate rainfall during the growing season in the drier soil-climatic zones. This is particularly the case in the Brown and Dark Brown soil zones. (See Fig. 1 for map of major soil zones on the prairies).

The amount of extra moisture conserved by one year of fallowing varies with soil type, climate and seasonal weather conditions. Estimates of the potential benefits of each mm of water conserved in increased yields of spring wheat have been calculated for the major soil zones in southern Saskatchewan (Henry and Harder, personal communications) and are summarized in the following table as water use efficiencies (WUE):

Soil zone	WUE (kg/ha per mm water)
Brown	9.2 - 9.8
Dark Brown	10.5 - 10.8
Black	11.2 - 11.8
Gray	12.5

The purpose of this bulletin is to present information on the variability over time and space of the extra moisture that can be conserved by summerfallowing in the prairie region. Knowledge of how much extra moisture is conserved can be helpful in deciding if and where summerfallowing can be eliminated from the crop rotation to help conserve the soil.

Producers are being encouraged to adopt a system of flexible cropping, wherein soil moisture reserves in spring are used to determine if land should be fallowed or recropped in a particular year (Bole and Freeze, 1986; also see Bootsma, et al. 1992). In cases where summerfallowing is required to reduce the risk of crop failure, conservation management techniques should be used to help prevent soil degradation. This includes conservation tillage (reduced tillage, maintaining surface trash, and so forth), using herbicides for weed control and stubble management (using stubble to trap snow, conserve additional moisture and help prevent erosion by wind and water).

Soil Moisture Budgeting

A budgeting technique called the Versatile Soil Moisture Budget (Baier et al., 1979) was used to estimate soil water content on a daily time scale for 30 years based on historical climate records. Water is added to the soil by precipitation and it is removed by evaporation, transpiration, runoff and deep percolation. Estimates of extra moisture conserved by fallowing were made using this budgeting technique. These were based on the climate data collected during 1956-85 and using the predominant soil texture and available water-holding capacity in each Agroecological Resource Area (ARA) as shown in Figure 2. ARA's are zones or areas which are relatively uniform with respect to soils, landscape features, climate and crop production potential. (Pettapiece, 1989; Eilers and Mills, 1990; G. Padbury, personal communication).

Although it is possible that climatic changes could occur in future as a result of the 'greenhouse' effect or other factors, any change is expected to be very gradual and therefore the past 30 years provide a reliable indication of extra moisture that may be conserved by fallowing for the next decade or more.

Estimates of Extra Moisture Conserved by Fallowing

Estimates of the additional moisture conserved by fallowing as compared to continuous cropping are presented in Figures 3, 4 and 5 for the 50, 10 and 90% probability levels, respectively. The concept of probability (or risk) is used because amounts of soil moisture conserved fluctuate from year to year. The 50% probability (approximately the long term average) is the value exceeded in half (50%) of the years; the 10% value is exceeded one year in 10 (or, conversely, it is not exceeded 9 years in 10) and the 90% value is exceeded 9 years in 10 (or, conversely, it is not exceeded one year in 10).

Figure 3 illustrates that at the 50% probability level, between one to 40 mm of extra moisture are conserved by fallowing in most prairie regions. This is increased to 41-80 mm in parts of western Alberta, areas north of Edmonton, and for much of the Peace River region. At the 10% probability level (Figure 4), the extra moisture conserved is 21 to 80 mm for much of the prairie region and 81 to 100 mm for the Peace River area (these values are exceeded 1 year in 10). At the 90% probability level (value exceeded 9 yr. in 10), the typical amount of moisture conserved is between zero and 20 mm (Figure 5).

The areas with greatest capability for conserving moisture through summerfallowing are not necessarily located where moisture is the most limiting. The driest areas in the prairies where summerfallowing is most useful for moisture conservation are the Brown and Dark Brown Chernozemic soil zones in southeastern Alberta and southwestern Saskatchewan (Figure 1). The extra moisture conserved by fallowing in these regions is typically under 40 mm at the

50% probability level (Figure 3) although in a few ARAs the increased moisture can be 61 to 80 mm or more 1 year in 10 (Figure 4). Thus the amount of additional yield increases due to fallowing in these regions may be under 400 kg/ha in half of the years but it can be up to 800 kg/ha in some years. The added yield represents 20% to 40% of yields currently being realized in these areas. In more humid regions such as in most parts of the Black and Dark Grey soil zones and the Peace River area, summerfallowing is not required even though relatively large amounts of moisture may be conserved (i.e. 61-80 mm at 50% probability (Figure 3)).

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Figure 1. Location of major soil groups in the prairie region

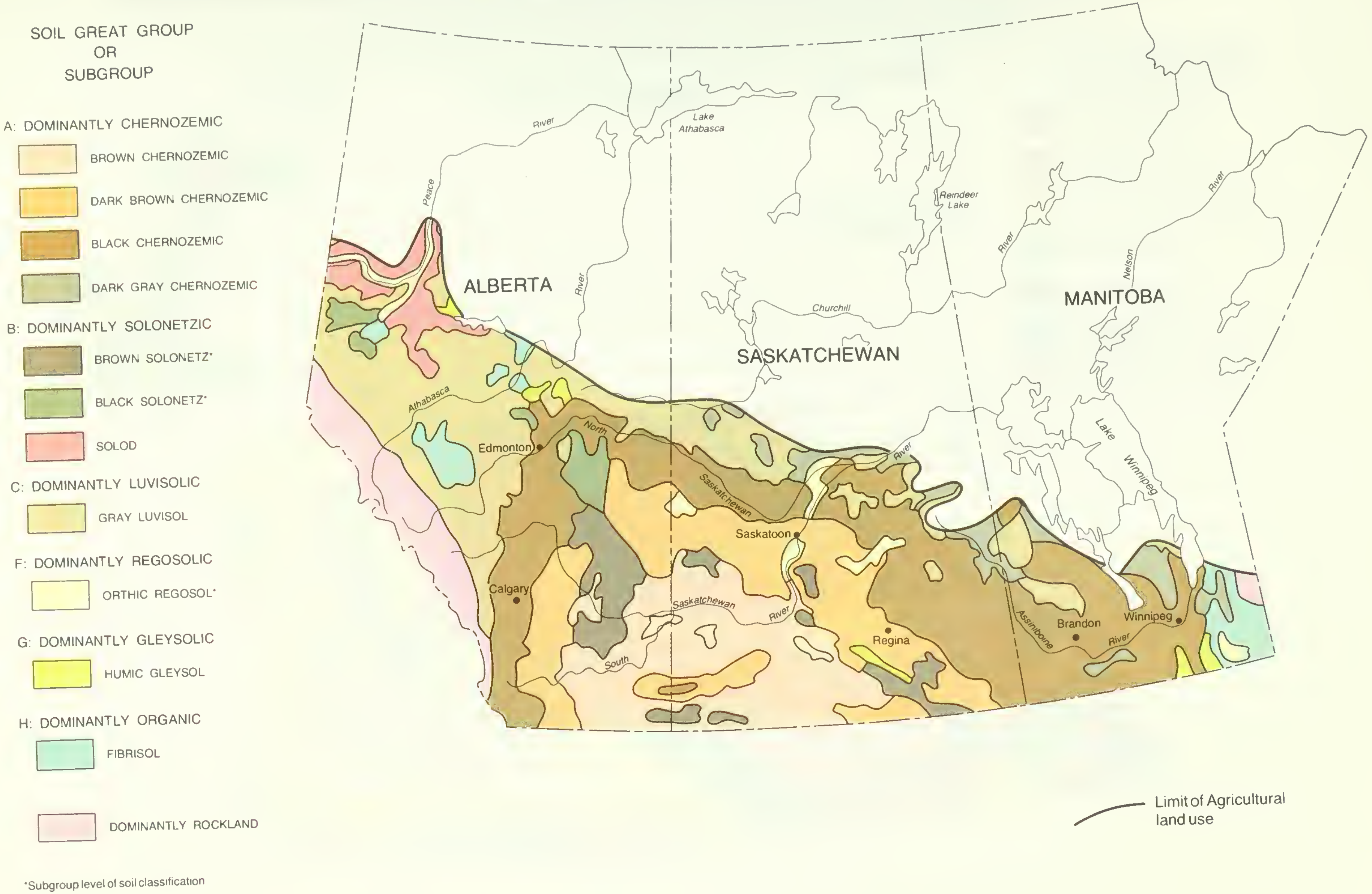


Figure 2. Predominant soil available water-holding capacity (AWC) of each ARA.

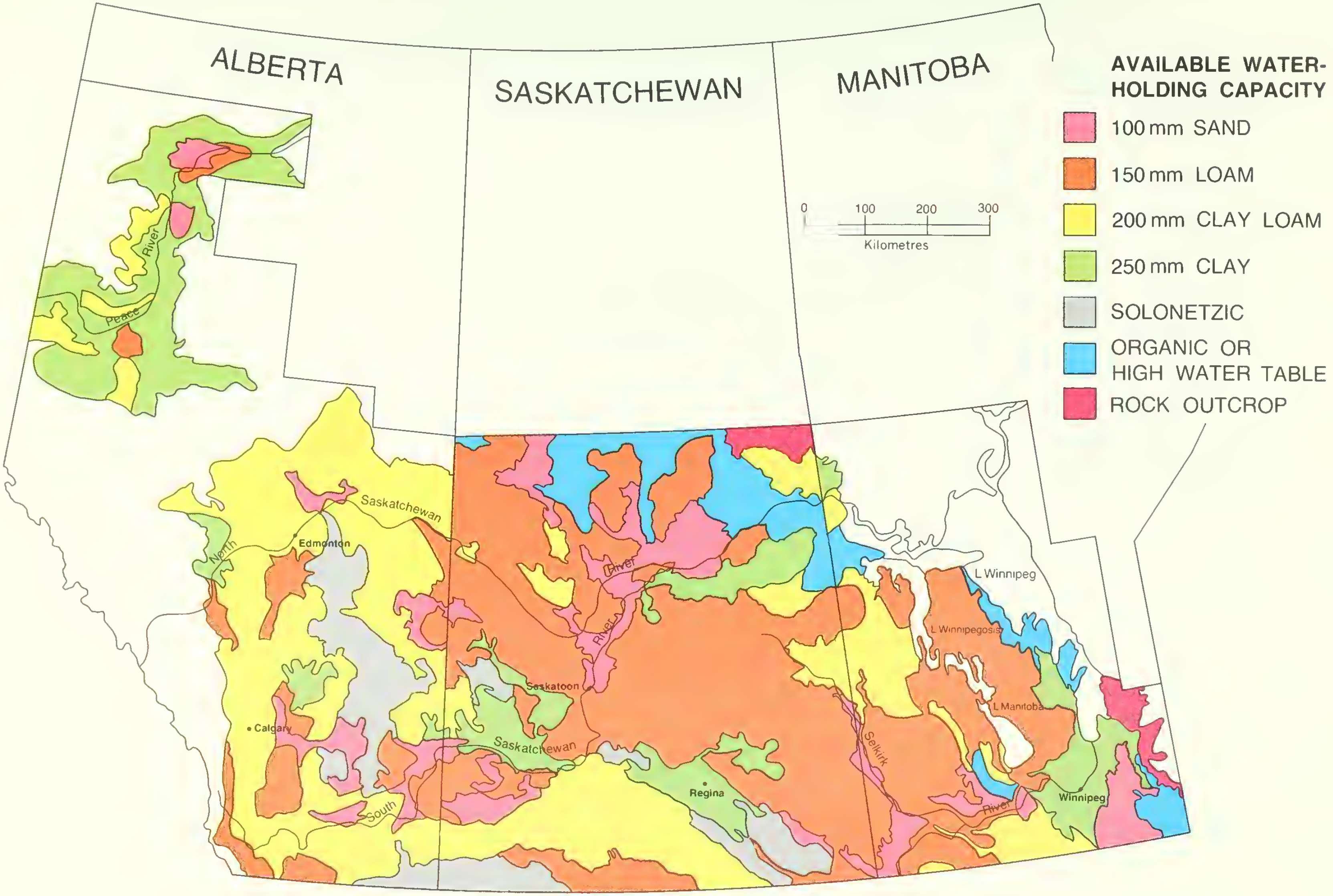


Figure 3. Estimated average (50% probability) amount of extra water conserved by fallowing.

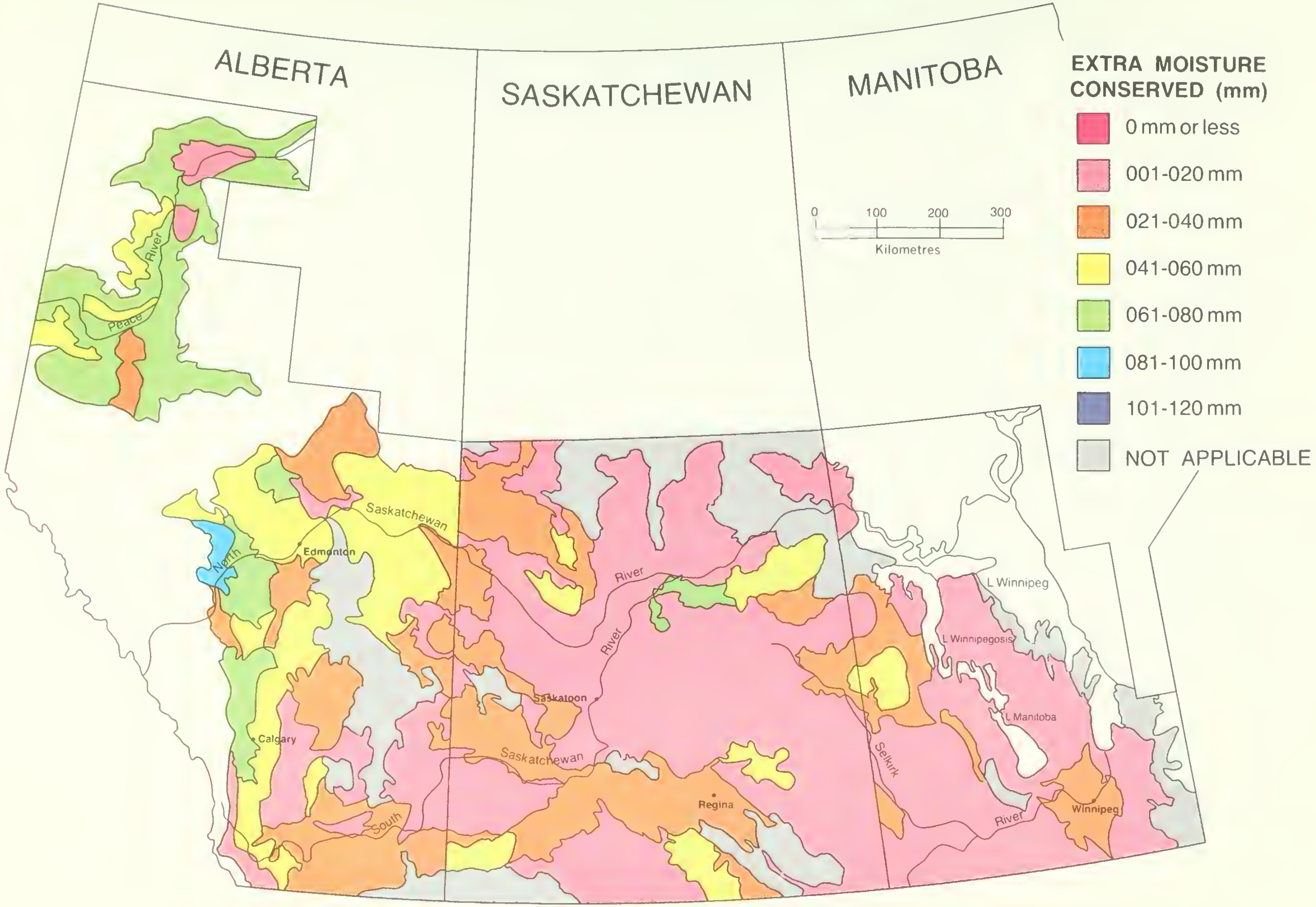
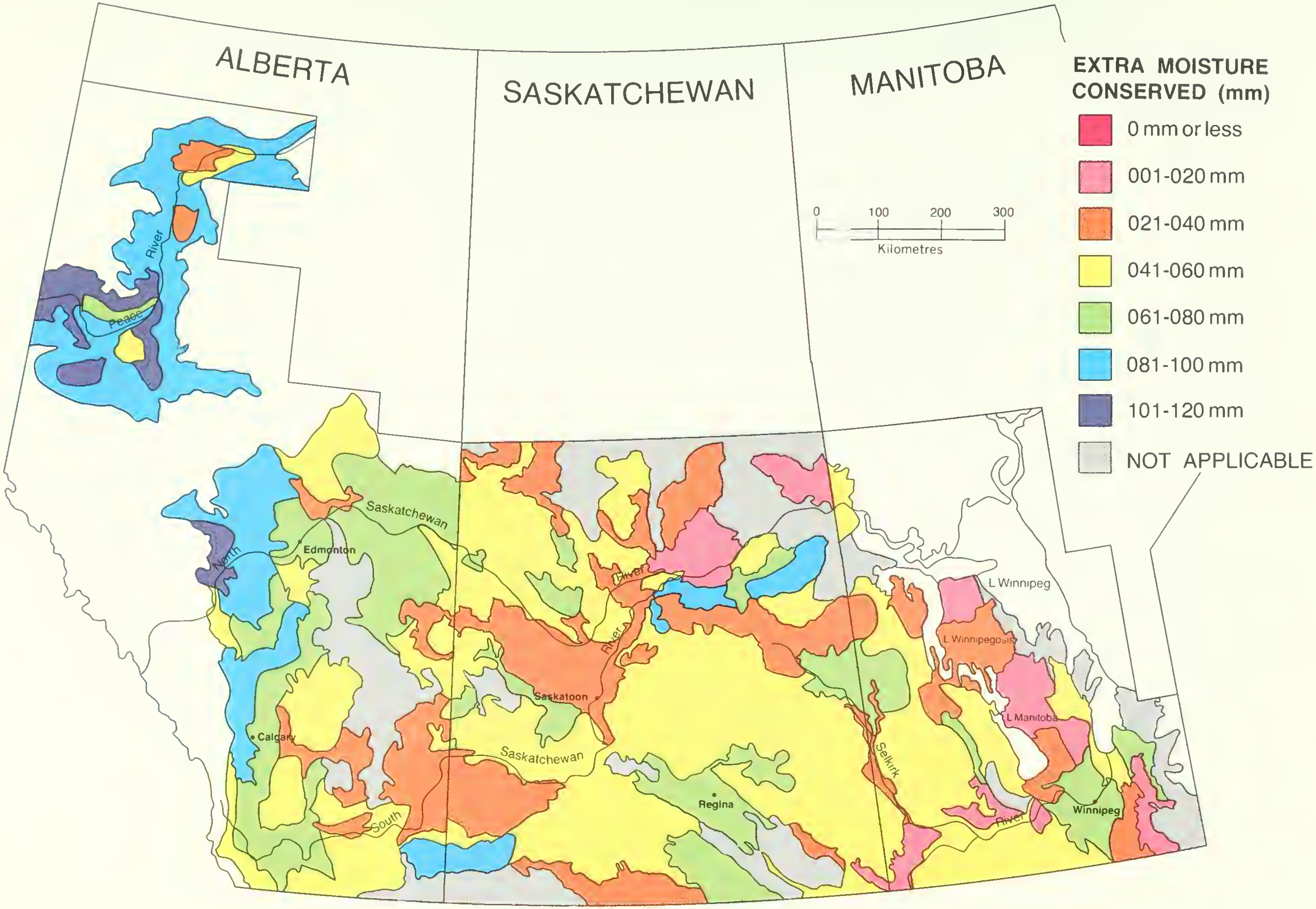


Figure 4. Estimated amount of extra water conserved one out of 10 years (10% probability) by fallowing.



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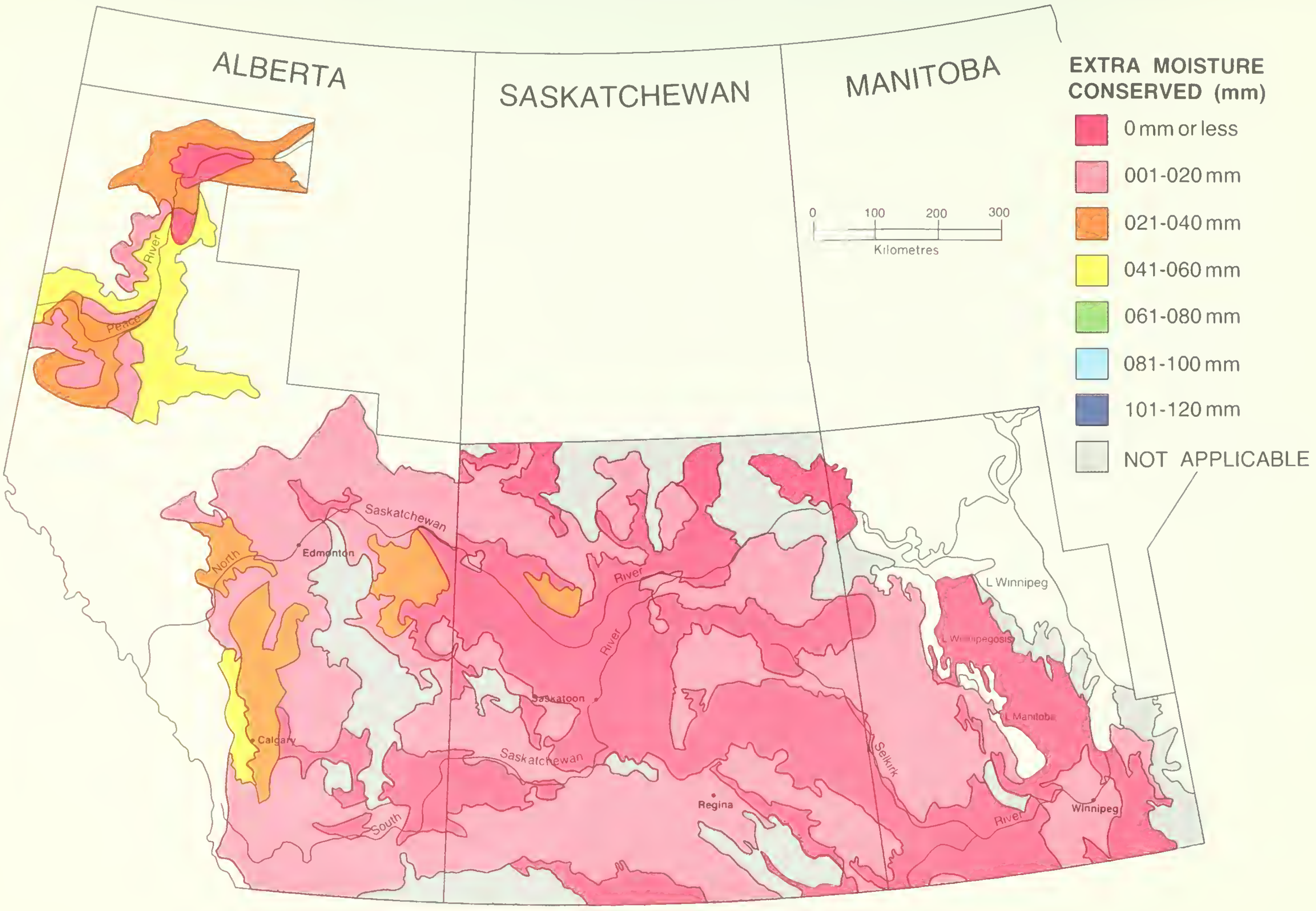

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